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Diffusion–reaction–induced stress in moving boundary cylindrical Li-ion battery electrodes

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ABSTRACT

Lithium (Li) inserted into or extracted from the electrode in Li-ion battery causes stress which may cause fracture of the electrode. A moving boundary model in a cylindrical Li-ion battery electrode accounting for reversible electrochemical reaction is obtained. The volumetric change created by Li diffusion and formation of reversible reaction product would generate the diffusion–reaction-induced stress in the electrode. The constitutive relation among Li concentration, reaction product, and stress is derived, and the numerical solutions of the concentration, reaction product, and stress fields are obtained. The effects of phase transformation and reversible electrochemical reaction on Li diffusion and stress in a cylindrical Li-ion battery electrode are analyzed.